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| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|--|-------------|----------------------|-------------------------------|------------------|
| 10/620,002 | 07/14/2003 | Dinesh Chopra | 2269-4373.2US (00-0036.02) | 7481 |
| 24247 | 7590 | 10/11/2007 | EXAMINER | |
| TRASK BRITT P.O. BOX 2550 SALT LAKE CITY, UT 84110 | | | UMEZ ERONINI, LYNETTE T | |
| | | | ART UNIT | PAPER NUMBER |
| | | | 1792 | |
| | | | NOTIFICATION DATE | DELIVERY MODE |
| | | | 10/11/2007 | ELECTRONIC |

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

USPTOMail@traskbritt.com

| | | | |
|------------------------------|-------------------------|---------------------|--|
| Office Action Summary | Application No. | Applicant(s) | |
| | 10/620,002 | CHOPRA ET AL. | |
| | Examiner | Art Unit | |
| | Lynette T. Umez-Eronini | 1765 | |

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) Responsive to communication(s) filed on 14 September 2007.
- 2a) This action is FINAL. 2b) This action is non-final.
- 3) Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) Claim(s) 1-25 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) Claim(s) _____ is/are allowed.
- 6) Claim(s) 1-25 is/are rejected.
- 7) Claim(s) _____ is/are objected to.
- 8) Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) The specification is objected to by the Examiner.
- 10) The drawing(s) filed on 7/14/2003 is/are: a) accepted or b) objected to by the Examiner.
 Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
 Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) All b) Some * c) None of:
 1. Certified copies of the priority documents have been received.
 2. Certified copies of the priority documents have been received in Application No. _____.
 3. Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

| | |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date: _____ |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date: _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 9/14/2007 has been entered.

Claim Rejections - 35 USC § 102

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

3. Claims 1-11 and 15-19 are rejected under 35 U.S.C. 102(e) as being anticipated by Hudson (US 5,972,792).

Hudson teaches a method of chemical-mechanical planarization of a substrate on a fixed abrasive polishing pad in which a planarizing solution is dispensed onto the pad (Abstract). The planarizing solution may be used to planarized titanium and aluminum on a tungsten plug, a titanium nitride barrier layer (column 4, lines 1-25) and

copper (column 4, lines 50-52); has a pH of between 3.0 and 10.0 (column 4, lines 53-54); includes an oxidant such as ferric nitrate, hydrogen peroxide, potassium iodate, and bromine (column 4, lines 35-37 and 53-56); and has a mixture of 0.1%-1.0% benzotriazole, 0.1%-5.0% nitric acid, and deionized water (column 4, lines 56-65). The above read on,

Since Hudson uses a composition that is substantially free of abrasives as claimed by applicants, then using Hudson's slurry in the same manner as claimed in the present invention would inherently result in,

A slurry for use in polishing a copper structure of a semiconductor device, the slurry being substantially free of abrasives and formulated to substantially concurrently polish copper and a barrier material with the barrier material being removed at substantially the same rate as or at a slower rate than copper is removed, **in claim 1**;

being formulated to oxidize copper at substantially the same rate as or at a faster rate than the barrier material is oxidized, **in claim 3**;

wherein, in the slurry, the barrier material and copper have substantially the same oxidation energies, **in claim 4**;

wherein, in the slurry, the barrier material has an oxidation energy of about 0.25 V more to about 0.20 V less than an oxidation energy of copper in said slurry, **in claim 5**;

wherein, in the slurry, a rate of removal of the barrier material is up to about ten times slower than a rate of removal of copper, **in claim 6**;

wherein, in the slurry, a rate of removal of the barrier material is about two to about four times slower than a rate of removal of copper, **in claim 7**;

wherein the slurry is formulated to remove copper and the barrier material without substantially dissolving the barrier material that underlies remaining portions of copper, **in claim 8**;

wherein the slurry comprises at least one oxidizer, at least one pH control agent, and at least one inhibitor, **in claim 9**;

wherein the at least one oxidizer comprises at least one of an ammonium compound, a nitrate compound, and an amine compound, **in claim 10**; and

wherein the at least one oxidizer comprises at least one of hydrogen peroxide, potassium iodate, potassium permanganate, ammonium persulfate, ammonium molybdate, ferric nitrate, nitric acid, potassium nitrate, and ammonia, **in claim 11**.

Hudson also teaches planarizing with a silica-ceria fixed abrasive polishing pad (column 4, lines 38-39), which reads on the slurry being formulated for use with a fixed-abrasive polishing pad comprising at least one of aluminum dioxide, titanium dioxide, silicon dioxide, and cerium dioxide, **in claim 2**.

The said above encompasses,

wherein the slurry has a pH of about 2 to about 6, **in claim 15**;

wherein the at least one inhibitor comprises about 0.05% to about 2% of the weight of said slurry, **in claim 18**; and

wherein the at least one inhibitor comprises about 0.05 to about 0.2% of the weight of said slurry, **in claim 19**.

The said above also reads on,

wherein the at least one inhibitor comprises at least one of an azole, an amine, and a ring compound, **in claim 16**; and

wherein the at least one inhibitor comprises at least one of benzotriazole (BTA), mercaptobenzothiazole, tolytriazole, methylamine, diethylamine, pyridine, quinoline, dicyclohexamine nitrate, potassium silicate, ammonium borate, ammonium phosphate, and potassium dichromate, **in claim 17**.

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

5. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

6. Claims 12-14 and 21-25 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hudson (US '792) as applied to claim 1 above, and further in view of Nakazato et al. (US 4,459,216).

Hudson differs in failing to teach at least one pH control agent as recited in claim 14; and to specify the percent by weight of the oxidizer as recited in claims 12-13 and 23-24 and the complexing agent as recited in claims 21-22 and the temperature as recited in claim 25.

Nakazato teaches a chemical dissolving solution that is used in chemical polishing of metals such as copper. The chemical dissolving solution comprises hydrogen peroxide, an inorganic acid such as sulfuric, phosphoric, and nitric acid and an aromatic compound (Abstract; column 1, lines 5-15 and 28-33; and column 3, lines 12-24). The chemical dissolving solution includes 5g/l – 100 g/l (~0.1 to 10 %) of hydrogen and 100 g/l – 300 g/l of inorganic acid for polishing copper (column 3, lines 34-41) and can be used at a temperature of 10° - 80°C (column 3, lines 56-58). Nakazato also discloses a reference, which teaches a chemical polishing solution for copper, which comprises 0.5-30 % (w/w) sulfuric acid, 5-60% (w/w) hydrogen peroxide, and at least 0.1% (w/w) of an amine such as benzotriazole is used (column 1, lines 43-52).

Since the Nakazato reference is relied upon to teach an abrasive free solution comprising the specific concentration of oxidizer and complexing agent and operating temperature, which are known, then it would have been obvious to one having ordinary skill in the art at the time of the claimed invention to modify Hudson by using Nakazato's

concentration of oxidizer and complexing agent as well as temperature for the purpose of providing a chemical dissolving solution having good stability, a long life, and capability of producing a lustrous metal surface for use in chemical polishing (column 1, lines 5-6 and column 2, lines 33-37).

7. Claim 20 is rejected under 35 U.S.C. 103(a) as being unpatentable over Hudson (US '792) as applied to claim 1 above, and further in view of Suzuki et al. (US 5,885,334).

Hudson differs in failing to teach at least one complexing agent comprising at least one of glycine, ammonium citrate, ammonium phosphate, and ammonium acetate.

Suzuki teaches a polishing composition, which does not contain abrasive particles (column 6, lines 12-14). Suzuki also teaches the addition of a chelator and other additives such as glycine (same as applicants' complexing agent) can be added to the composition in order to give the composition additional properties. The addition of a chelator to the polishing composition is effective since metallic residue adhering to the polishing surface can be reduced (column 7, lines 14-28).

Since Suzuki illustrates a complexing agent is known, then it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify Hudson by employing a chelator (same as applicants' complexing agent) as taught in the Suzuki reference for the purpose of reducing metallic residue adhering to the polishing surface (Suzuki, column 7, lines 23-26).

Response to Arguments

8. Applicants' arguments filed 9/14/2007 have been fully considered but they are not persuasive. Applicants traverse the rejection of claims 1-11 and 15-19 under 35 § U.S.C. 102(e) as being anticipated by Hudson (US 5,912,792). Applicants argue Hudson does not expressly or inherently describe that any slurry disclosed therein is formulated to substantially concurrently polish copper and a barrier material, with the barrier material being removed at substantially the same rate as or at a slower rate than copper is removed.

Applicants' arguments are acknowledged, but are unpersuasive because Hudson teaches a planarizing solution may be used to polish a titanium nitride barrier layer (column 4, lines 1-25) and copper (column 4, lines 50-52); has a pH of between 3.0 and 10.0 (column 4, lines 53-54); includes an oxidant such as ferric nitrate, hydrogen peroxide, potassium iodate, and bromine (column 4, lines 35-37 and 53-56); and has a mixture of 0.1%-1.0% benzotriazole, 0.1%-5.0% nitric acid, and deionized water (column 4, lines 56-65). The above read on,

A slurry for use in polishing a copper structure of a semiconductor device, the slurry being substantially free of abrasives. Since Hudson uses a composition that is substantially free of abrasives as claimed by applicants, then using Hudson's slurry in the same manner as claimed in the present invention would inherently result in

the slurry being formulated to substantially concurrently polish copper and a barrier material with the barrier material being removed at substantially the same rate as or at a slower rate than copper is removed, **in claim 2;**

the slurry being formulated to oxidize copper at substantially the same rate as or at a faster rate than the barrier material is oxidized, **in claim 3**;

the slurry, the barrier material and copper have substantially the same oxidation energies, **in claim 4**;

the slurry, the barrier material has an oxidation energy of about 0.25 V more to about 0.20 V less than an oxidation energy of copper in said slurry, **in claim 5**;

the slurry, a rate of removal of the barrier material is up to about ten times slower than a rate of removal of copper, **in claim 6**;

the slurry, a rate of removal of the barrier material is about two to about four times slower than a rate of removal of copper, **in claim 7**; and

the slurry is formulated to remove copper and the barrier material without substantially dissolving the barrier material that underlies remaining portions of copper, **in claim 8**.

Further it is noted the claims are directed to a slurry (composition), which is defined by what it is made of and not by its use. No patentable weight is given to the "intended use" of the slurry.

Applicants argue Hudson lacks "sufficient specificity" in providing any specific combination of slurry components or any specific slurry formulation, including relative amounts of the various components of the slurry that would meet the requirements of claim 1.

Applicants' argument that Hudson lacks "sufficient specificity" is acknowledged. However, Applicants argument is unpersuasive because the claims do not require any specific formulation and relative amounts of various slurry components to meet the limitations of claim 1.

Applicants argue, from the prior art, including that discussed in the BACKGROUND to the above referenced application, the slurry of Hudson would not necessarily remove a barrier material at substantially the same rate as or a slower rate than copper is removed. Applicants also argue the examiner's assertion of using Hudson' slurry in the same manner as claimed would inherently result in the slurry being formulated to substantially concurrently polish copper and a barrier material with the barrier material being removed at substantially the same rate as or at a slower rate than copper is removed.

Applicants' arguments are acknowledged. It is unclear which prior art and referenced application are being relied upon by Applicants to show Hudson would not necessarily remove a barrier material at substantially the same rate as or a slower rate than copper is removed. Nevertheless, Applicants' argument is unpersuasive because Hudson teaches a planarizing solution that has no abrasives (column 4, lines 1-25, 35-37, and 50-56) as explained above and which is the same as Applicants' claimed slurry. Hence using Hudson's composition in the same manner as in the claimed invention would inherently result the same to remove a barrier material at substantially the same

rate as or a slower rate than copper is removed, in the absence of a teaching of unexpected results.

Applicants argue claims 2-11 and 15-19 are allowable for depending either directly or independent claim 1, since Hudson provides no express or inherent description of a slurry. Applicants' arguments are unpersuasive since Hudson uses a composition that is substantially free of abrasives as claimed by applicants, then using Hudson's slurry in the same manner as claimed in the present invention would inherently result in the slurry

being formulated for use with a polishing pad that includes fixed aluminum dioxide, titanium dioxide, silicon dioxide, or cerium dioxide abrasive particles, in Claim 2;

being formulated to oxidize copper at substantially the same rate or at a faster rate than a barrier material is oxidized, in Claim 3;

wherein, in said slurry, the barrier material and copper have substantially the same oxidation energies, in Claim 4;

wherein, in said slurry, the barrier material has an oxidation energy of about 0.25 V more to about 0.20 V less than an oxidation energy of copper, in Claim 5;

wherein, in said slurry in which a rate of removal of a barrier material is up to about ten times slower than a rate of removal of copper, in Claim 6;

wherein, in said slurry in which a rate of removal of a barrier material is about two to about four times slower than a rate of removal of copper, in Claim 7; and

wherein said slurry is formulated to remove copper and a barrier material without substantially dissolving barrier material that underlies remaining portions of copper, in Claim 8.

Applicants' request for the withdrawal of the 35 U.S.C. 102(a) rejections of claims 1-11 and 15-19 is acknowledged. However, NOTE: The rejection of claims 1-11 and 15-19 were made under "35 U.S.C. §102(e)" and not under 35 U.S.C. §102(a) as indicated by Applicants.

Applicants traverse the rejection of Claims 12-14 and 21-25 under 35 U.S.C. §103(a) over Hudson (US '792) in view of Nakazato et al. (US 4,459,216) and argue the Claims are allowable, among other reasons, for depending directly or indirectly from Claim 1, which is allowable. The same response above for arguments presented for Claim 1 is applicable here.

As to claims 12-14 and 21-25, Applicants further argue Hudson teaches away from dissolving conductive material while oxidizing and polishing the same (col. 4, lines 1-19 and col. 5, lines 55-64). In contrast, Nakazato teaches a chemical dissolving solution having a good dissolving capacity for various kinds of metals (col. 2, lines 33-35), which is insufficient to overcome the fact that Hudson teaches away from the asserted combination. Hence, one would not be motivated to combine these references.

Applicants' arguments are acknowledged but are unpersuasive because the feature of dissolving conductive material while oxidizing and polishing the same is not

required by the claimed invention. Applicants' arguments are also unpersuasive because the Nakazato reference is relied upon to cure Hudson's deficiencies by teaching an abrasive free solution comprising the specific concentration of oxidizer and complexing agent and operating temperature.

In response to Applicants' argument that there is no suggestion to combine the references, the examiner recognizes that obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so found either in the references themselves or in the knowledge generally available to one of ordinary skill in the art. See *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988) and *In re Jones*, 958 F.2d 347, 21 USPQ2d 1941 (Fed. Cir. 1992). In this case, the reason for combining Hudson and Nakazato is to cure Hudson's deficiencies, in which the Nakazato reference is relied upon to teach an abrasive free solution comprising the specific concentration of oxidizer and complexing agent and operating temperature, which are known. Hence, it would have been obvious to one having ordinary skill in the art at the time of the claimed invention to modify Hudson by using Nakazato's concentration of oxidizer and complexing agent as well as temperature for the purpose of providing a chemical dissolving solution having good stability, a long life, and capability of producing a lustrous metal surface for use in chemical polishing (Nakazato, column 1, lines 5-6 and column 2, lines 33-37).

Further it is noted the claims are directed to a slurry (composition), which is defined by what it is made of and not by its use. No patentable weight is given to the "intended use" of the slurry.

Applicants traverse the rejection of Claim 20 under 35 U.S.C. §103(a) over Hudson (US '792) in view of Suzuki et al. (US 5,5885,334) and argue Claim 20 is allowable, among other reasons, for depending directly or indirectly from Claim 1, which is allowable. The same response above for arguments presented for Claim 1 is applicable here.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Lynette T. Umez-Eronini whose telephone number is 571-272-1470. The examiner is normally unavailable on the First Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nadine Norton can be reached on 571-272-1465. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic

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Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

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Itue

September 22, 2007

NADINE G. NORTON
SUPERVISORY PATENT EXAMINER
